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Ion Exchange Determines Iodine-131 Concentration in Aqueous Samples

The problem:

To develop a rapid and sensitive procedure for the analysis of inorganic radioiodide in aqueous media. Iodine-131, an important radiological health hazard, can accumulate in substances such as milk, water, and urine, and is difficult to measure accurately when present in small concentrations (less than 25 picocuries per liter).

The solution:

Separate the radioactive iodine-131 as the iodide ion on a silver chloride column. The sample can then be analyzed by gamma counting either as part of the column, as iodic acid after elution from the column, or as silver iodide after precipitation from the eluate. The activity in the final precipitate may also be determined by beta counting.

How it's done:

The aqueous sample is first mixed with approximately 20 mg of iodide carrier as standardized potassium iodide solution and then transferred with distilled water to a light-tight column (approximately 2.5 cm in diameter) containing approximately 7 cm of 20 to 40 mesh silver chloride supported by a glass wool plug. The relatively large sized granules of silver chloride permit the use of high flow rates (40 to 50 ml per minute) without the necessity of applying vacuum or pressure. After the sample is run through the column, the effluent is discarded and the column is washed with distilled water. The column is then filled with a solution of 0.1N sulfuric acid saturated with chlorine gas, and this solution is allowed to stand in the column for about 5 minutes.

When the acidified chlorine water is drained from the column, the iodic acid in the eluate can be directly analyzed by gamma counting. The time required to

analyze a 1-liter sample by this method is approximately 30 minutes (exclusive of counting time). If beta counting or increased sensitivity is desired, the iodine is subjected to two oxidation-reduction solvent-extraction cycles and finally precipitated as silver iodide prior to counting.

This procedure has been used in extensive tests conducted on samples of milk. The chemical and radiochemical yields for both added and metabolized iodide were 90% to 95% for homogenized milk and 85% to 95% for raw milk. The total procedure (excluding counting time) takes approximately 2 hours and can detect less than 2 picocuries of iodine-131 in 1 liter of milk.

Additionally, this procedure with slight modifications has been applied successfully to urine and environmental water samples. It is applicable in general to the analysis of radioiodine in aqueous media. However, in those cases where the iodine may be present in several oxidation states or where it is not present as an iodide, a series of oxidation-reduction steps are required after the addition of an iodine carrier to effect rapid exchange with the iodide carrier, and to convert all of the iodine to iodide prior to addition of the sample to the silver chloride column.

Notes:

1. Although this procedure is specific only for iodine occurring as inorganic iodide, organic iodide in the sample types thus far analyzed comprises only a small fraction of the total iodine present. For example, in the milk the total iodine-131 can be estimated with adequate accuracy by assuming 10% (the normal maximum) of the total iodine is present in organic form.

(continued overleaf)

2. Additional details are contained in: *Anal. Chem.*, vol. 38, p. 1171-1175, August 1966.
3. Inquiries concerning this innovation may be directed to:

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Source: W. D. Fairman and J. Sedlet
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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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